We therefore summarize the explanation and decision on action:

1). Applicant would withdraw "Claim 2"

2). Applicant respectfully submits you allow the following claims:

Claim 1, 3-4, 6-10, 12-14 and 16-23

3). Applicant respectfully submits you allow the following are allowable but objected to as being dependent upon rejected base claims.

Claim 5, 11 and 15.

Reply and explanation of the differences to the Official Action summary

"Claim 1" recites a method for motion estimation:

1). saving motion vectors, MVs of a partial or an entire frame of at least one frame into a storage device for the best match macroblock searching of the current or the neighboring frames.

2). calculating the motion vector, MV, of a macroblock within a frame by firstly searching a corresponding or the neighboring macroblocks of the current or at least one neighboring frame.

We directly (instead of hierarchically, like 2-3 levels) calculate the motion vector by referring to one of the neighboring frame with the partial or full frame

motion vectors saving to a storage device.

In contrast, the cited art of **Koba et al US-6269174.** calculates and saves motion vectors of all blocks into memory. AND calculates levels of macroblocks characteristic values of groups of each group of macroblocks .... As cited in the following sentences:

Koba et al US-6269174 Claim 1 recites: ...

(a) calculating of a set of characteristic values for every coordinate pair (x,y) of a permissible reference macroblock position in the reference frame and storing the calculated values in a memory;

(b) calculating N levels of group characteristic values for a plurality of groups comprising multiple admissible reference macroblocks in each group and storing said calculated group characteristic values in a memory;

(c) . . . .

(d) . . . .

(e) . . .

(f) . . . .

Therefore, Claim 1, Claim 19-20 of this invention and are quite different from Koba et al US-6269174 which has art of calculating multiple levels of groups motion vectors.

Therefore, the Applicant respectfully submits you allow Claim 1, and Claim 19-20.

Claim 3 recites the way of calculating the "common" motion vector of a frame. "by calculating the majority of motion vectors and identifying it as the FMV, frame motion vector ..." This is one of the main inventions, after identifying the FMV, the "Starting point" of majority macroblock have a good reference to predict. This claim clearly recites the "common movement" of a frame which does not matter with the searching window as cited in the art of Piccinelli et al US-6829373 which "auto setting of optimal search window dimensions for motion estimation comprising identifying the majority (maximum) MV to determine the optimal search window ....)

In Koba et al US-6269174, even Kaba teaches "estimating/predicting more than two Motion vectors ...." Those multiple MVs are used to predicting the neighboring or next motion vector. In this invention, the calculating majority motion vectors is to identify the "common" movement which is the base for calculating the starting point which clearly differs from the art of Koba et al US-6269174.

Therefore, the Applicant respectfully submits you allow Claim 3.

Claim 4 recites that applying the frame motion vector, FMV to be the initial point of the best match block searching in current frame or a neighboring frame. Not like the art of Koba et al US-6269174 which specify a specific macroblock MV. The key difference between ours and Koba et al US-6269174 is that we clearly identify the "common" movement of a frame as the frame MV and apply it to the initial point of the majority blocks of a "current" or a neighboring frame. Therefore, the Applicant respectfully submits you allow Claim 4.

Claim 6, and Claim 21-22 recite the **"prioritized"** initial point prediction mode which is specified by MVs of previous and neighboring frames. This is differs from MPEG committee recommendation of predicting and is completely different from Koba et al since Koba does not specify the priority of initial point prediction and the art of Piccinelli et al US-6829373 teaches mainly the **"auto setting of optimal search window dimension for motion estimation ...."** Which does not relate to this invention or any of the "claims" of the present invention. Therefore, the Applicant respectfully submits you allow Claim 6, and Claim 21-22.

Claim 2 recites that applying more than one MV of the current frame or a

neighboring frame to encode the MVs of other macroblocks. This is similar to what Koba et al since Koba et al teach the art of selecting the MV with minimum length which requires less bits in encoding and uses that MV to predict other macroblocks.

So, we would withdraw this claim.

Claim 7 recites an adaptive threshold value is compared to the mean absolute difference, MAD of the targeted macroblock to determine whether to select or to give up the targeted macroblock which is under the best match macroblock searching. This art decides how to "early stop" motion estimation by examining the MAD value from block to block by accumulating the error and comparing it to an adaptively adjusted threshold.

Koba et al indeed examines a so named "threshold value" to the MAD also for early stop and storing the MV into a memory. The main difference between us is our design applies "Adaptive adjustment" of the accumulative threshold value which can reach regional better image quality visually instead of a predetermined threshold value in Koba et al.

Therefore, the Applicant respectfully submits you allow Claim 7.

Claim 8 recites that applying the adaptively predetermined values of the MV, the MAD or the block differences to determine the sub-sampling ratio, or to decide a refiner or a coarser pixel resolution, or to decide the prediction mode of the initial point of searching or to decide whether to skip block, or to decide whether to early select or to early give up the current macroblock.

This art of the present invention gains significant enhancement in performing the motion estimation which let's restate again: the locally or regionally examining the accumulative MAD and compare to adjusted threshold value (low complexity will allow lower threshold value, higher complexity allows higher threshold value) determine the following mechanisms which significantly reduce the computing time:

1). refiner or a coarser pixel resolution

2). Sub-sampling ration

3). Skipping block

4). Early stop motion estimation

In contrast, the cited art of Koba et al teaches the threshold value which is preset for majority of macroblocks for reducing motion estimation times, our art recites clearly that adaptively applying regional accumulative MAD and

compare to the dynamical threshold value both are not mentioned in Koba et al. and gains much enhancement in performing motion estimation.

Therefore, the Applicant respectfully submits you allow Claim 8.

Claim 9 recites that applying sub-sampled pixels to the calculations of the MAD, MV, FMV or block differences for the motion estimation.

In contrast, the cited art of Koba et al, it indeed teaches "... Fast ME with Pixel Subsampling, is based on limiting the number of pixels used in the calculation of matching criterion .... " But, it does not include the calculation the MAD, MV or FMV which are clearly indicated in this claim.

Therefore, the Applicant respectfully submits you allow Claim 9.

Claim 10 recites that a higher sub-sampling ratio is applied to calculate the motion vector for those macroblocks with lower value of MV or MAD. This is based on claim 8 and 9 with respect to the locally or regionally examining the accumulative MAD to determine the sub-sampling ratio instead of the art of Koba et al which really applies sub-sampling means to reduce the calculating times but does not include calculating the MAD or does not depend

on the regional or accumulative MAD before deciding the ration of sub-sampling.

In contrast, Chen et al teaches from its title "Method for performing motion estimation with Walsh-Hadamard transform (WHT)" the motion estimation done in "Transform" or said frequency domain which is completely different from ours. And the prior arts mention in Chen el al does not include locally or regionally examining the accumulative MAD to determine the sub-sampling ratio.

Therefore, we suggest you kindly reconsider allowance of the Claim 10.

Claim 12 recites that the position of the pixel selection of the sub-sampling changes from frame to frame. As in description, the position of sub-sampling changes from frame to next frame to gain the best quality since rotating the position allows covering more amount of pixels. This claims is a means to avoid image quality degradation when applying sub-sampling means.

In contrast, Koba et al do not teach the change of position in different frame.

Therefore, the Applicant respectfully submits you allow Claim 12.

Claim 13 recites that a refiner pixel resolution is applied to the macroblocks having higher MV values or their neighboring macroblocks of the

current frame or the neighboring frames. This means plays an important role for enhancing the speed when performing motion estimation while still keeping good image quality. When the accumulative error is compared to the regionally adjusted threshold value to decide, if the motion is large then applying the refiner resolution.

In contrast, Koba et al do not teach the counting on the regionally adjusted threshold value deciding the refiner resolution. Instead, it follows MPEG standard recommended approach of firstly motion searching in course resolution, after the best match is identified in course resolution, it takes next step which is motion estimation in refiner resolution. Koba et al do not teach the dependency on the value of MV which is the key difference.

Therefore, the Applicant respectfully submits you allow Claim 13.

Claim 14 and Claim 23 recite that a courser pixel resolution is applied to the macroblocks having lower MV values or their neighboring macroblocks of the current frame or the neighboring frames. This means is similar to Claim 13. In contrast, Koba et al do not teach the counting on the regionally adjusted threshold value deciding the refiner resolution. Instead, it follows MPEG standard recommended approach of firstly motion searching in course

resolution, after the best match is identified in course resolution, it takes next step which is motion estimation in refiner resolution. Koba et al do not teach the dependency on the value of MV which is the key difference.

Therefore, the Applicant respectfully submits you allow Claim 14 and Claim 23.

"Claim 16" recites that the best match block searching is applied to the blocks with the MV different from the frame motion vector, the FMV.

This is one of keys of saving computation times by selectively determining which macroblock need to go through the motion estimation. In this claim, we limit the macroblock to only those macroblock which do not have the same motion vector with frame motion vector, FMV.

In contrast, the cited art of **Zhu et al.** does not specify which and how selecting macroblocks to go through the motion estimation mechanism.

Therefore, the Applicant respectfully submits you allow Claim 16.

"Claim 17" recites that the best match block searching is applied to the neighboring blocks with the MV different from the frame motion vector, the FMV. In this claim, we recite that the motion estimation mechanism is applied to those macroblocks surrounding the macroblocks which go through

the motion estimation.

In contrast, the cited art of **Zhu et al.** does not specify which macroblocks need to go through the motion estimation mechanism.

Therefore, the Applicant respectfully submits you allow Claim 17.

"Claim 18" recites that "the majority of macroblocks within a frame or a region need to go through the motion estimation "from time to time"..." The term "from time to time" is determined by a periodic duration (this is not defined or limited in this claim like once every 10 frames or 20 frame ... etc.) or as mentioned in the following sentence of which claim "when the accumulated amount of macroblocks with movement different from the FMV reaches a predetermined value.

In contrast, the cited art of **Zhu et al.** does not teach how frequent or whether the motion estimation mechanism is applied to macroblock within a frame.

Therefore, the Applicant respectfully submits you allow Claim 18.

Claim 19 recites an apparatus for motion estimation comprising:

1). a device determining the motion vector, MV of the current frame or at least one neighboring frame by comparing the targeted macroblock to the

neighboring macroblocks; and

2). a storage device that saves the MV of a partial or an entire frame of the current frame or at least one neighboring frame;

Based on previous explanation with details in Claim 1, the corresponding apparatus in this claim is clearly different from the art of Koba et al. And the following claim (Claim 20) is a dependent claim on Claim 19 (and Claim 1). Therefore, the Applicant respectfully submits you allow Claim 19 and Claim 20.

For at least above reasons, Applicant respectfully submits that the rejection to claim 1, 3-4, 6-10, 12-14 and 16-23 of the present invention should be withdrawn and claim 1, 3-4, 6-10, 12-14 and 16-23should be allowed. We agree to withdraw Claims 2 . Since the claims 5, 11 and 15 depend from should be allowed.

In summary, Applicant respectfully submits that the application is in condition for allowance, for which early action is requested.

Respectfully submitted,

By: _____ Date: 5th , March, 2007